REMARKS/ARGUMENT

In the most recent Office Action, claims 2-17 were pending, while claims 2, 3, 11 and 12 are withdrawn from consideration. Claims 4-10 and 13-17 are rejected. Claims 4, 8-9 and 13-15 are amended. Accordingly, claims 2-17 are pending in the present application. No new matter is added.

Claim Rejections - 35 U.S.C. §112

Claims 4-10 and 13-17 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter that Applicant regards as the invention. In particular, the Office Action cites various issues with lack of antecedent basis and clarity of recitation.

Applicant has amended the claims to improve clarity and to overcome the rejection under 35 U.S.C. §112, second paragraph. Applicant respectfully believes that the claims now recite the subject matter of the invention with reasonable certainty to permit one of ordinary skill in the art to understand the scope that is claimed. Applicant accordingly respectfully requests that the rejection under 35 U.S.C. §112, second paragraph, be reconsidered and withdrawn.

Claim Rejections - 35 U.S.C. §103

Claims 4-7 are rejected under 35 U.S.C. §103(a) as being unpatentable over Applicant's prior art admission (APAA) in view of Gofuku (U.S. Patent No. 5,767,560). In particular, the Office Action states that all of the elements of claim 4 are taught in APAA, or are well known in the art, while the disclosure by Gofuku suggests the use of InAlGaAs material. Applicant respectfully traverses the rejection.

Claim 4 is amended to improve the clarity of recitation already defined in the present invention over that of the prior art references. For example, claim 4 now recites:

> said photo-absorption layer being spaced from said edge of said substrate adjoining said end surface.

This particular recitation in claim 4 is one of the critical features already recited in the claim, that is now restated to improve the clarity of the definition of the scope of the invention

recited in claim 4. None of the cited prior art references teach this element, either alone or in combination. Accordingly, Applicant believes that the present recitation of claim 4 is not obvious over the cited prior art references, and respectfully requests that the rejection of claim 4 under 35 U.S.C. §103(a) be reconsidered and withdrawn.

Claims 5-7 depend upon and further limit claim 4, and should be allowable for the same reasons, in addition to the further recitations contained in each of the dependent claims. Accordingly, Applicant respectfully requests that the rejection of claims 5-7 under 35 U.S.C. §103(a) be reconsidered and withdrawn.

Claims 8 and 9 are apparently rejected under 35 U.S.C. §103(a) as being unpatentable over APAA in view of Taki et al. (Japanese Patent No. 2,016,510). In particular, the Office Action states that it would have been obvious to have provided a grooved optical fiber holder/guide with the APAA to provide all of the elements of claims 8 and 9. Applicant respectfully traverses the rejection.

Claim 8 recites that the semiconductor photo-detector includes:

> a photo-absorption layer provided on said top surface of said substrate and spaced from said edge.

As with the invention recited in claim 4, claims 8 and 9 recite elements that are not provided in any of the prior art references, either alone or in combination. Accordingly, all of the claim limitations are not shown in any prior art reference, or combination of prior art references. Applicant therefore respectfully requests that the rejection of claims 8 and 9 under 35 U.S.C. §103(a) be reconsidered and withdrawn.

Applicant notes that although there is a lower standard of obviousness applied to product by process claims, there is no teaching in any of the cited prior art references, or suggestion, that the light incident facet can be fabricated by etching, let alone that the V or U-shaped groove can be fabricated simultaneously with the light incident facet. Applicant notes that the improvement and advantages obtained by being able to produce the right incident facet by etching should make the present invention recited in claim 9 non-obvious over the cited prior art references. In addition, claim 9 is thought to be allowable as being dependent upon an allowable base claim, for the same reasons that claim 8 should be allowable, and in addition to the further recitations

contained in claim 9. Accordingly, reconsideration and allowance of claim 9 is respectfully requested.

Claims 10 and 13-15 are rejected under 35 U.S.C. §103(a) as being unpatentable over APAA in view of Taki et al. and Konishi et al. (U.S. Patent No. 5,596,210). In particular, the Office Action states that the claims contain obvious structure over the combination of the cited prior art references. Applicant respectfully traverses the rejection.

With respect to claim 10, Applicant notes that it is dependent upon claim 8, and therefore contains all the recitations of claim 8, in addition to the further recitations provided by claim 10 itself. Applicant further notes that, although Konishi et al. appears to disclose silicon rubber as a coupling agent, it fails to disclose the structural elements recited in claim 8, upon which claim 10 depends. As noted above, claim 8 recites elements that are not taught or suggested in any of the other cited prior art references. Accordingly, claim10 also recites elements that are not shown or suggested in any of the cited prior art references, either alone or in combination. That is, because Konishi et al. does not cure the deficiency with regard to elements not taught by APAA or Taki et al., either alone or in combination, claim 10 recites elements that are not shown in any of the cited prior art references. Applicant thus respectfully believes that claim 10 should be patentable over the cited prior art references, and respectfully requests that the rejection under 35 U.S.C. §103(a) be reconsidered and withdrawn.

As discussed above with respect to claims 8-10, claims 13-15 recite elements that are not shown in any of the cited prior art references, either alone or in combination. For example, claim 13 recites:

> an abutting portion extending from said substrate a specified lateral distance beyond said edge; and
>
> wherein incident light from an optical waveguide precisely positioned by contacting against said abutting portion of said end surface is refracted at said light incident facet.

Applicant notes that the above and other elements recited in claim 13 are not taught or suggested in any of the cited prior art references.

The Office Action states that the recitation in claim 13 is obvious structure, but fails to provide any evidence supporting this conclusion. With regard to rejections under 35 U.S.C. §103, the Examiner ***must provide evidence*** which as a whole shows that the legal determination sought to be proved (i.e., the reference teachings establish a *prima facie* case of obviousness) is more probable than not. MPEP §2142 (emphasis added). None of the prior art references teach or suggest the elements recited in claim 13. Instead, the Office action states, "claims 10, 13-15 are obvious structure," which is merely the legal determination sought to be proved. Accordingly, Applicant believes that the rejection of claim 13 under 35 U.S.C. §103(a) is overcome, and respectfully requests that it be reconsidered and withdrawn.

With respect to claim 14, Applicant notes that none of the cited prior art references appear to disclose:

> an upper layer of said photo-absorption layer is terminated with a substance having a smaller refractive index than a semiconductor layer.

Accordingly, Applicant respectfully believes that claim 14 is allowable over the cited prior art references for reciting elements not shown or suggested by the cited prior art references, and for the same reasons that claim 13 is allowable. Reconsideration and allowance of claim 14 is respectfully requested.

Claim 15 recites:

> a solid or liquid interposed between said light incident facet and said optical waveguide,
>
> with the optical waveguide disposed opposing said light incident facet.

Applicant notes that none of the cited prior art references teach or suggest this element. Accordingly, Applicant believes that claim 15 should be allowable over the cited prior art references for this reason, and for the reasons discussed above with regard to claim 13. Reconsideration and allowance of claim 15 is respectfully requested.

Allowable Subject Matter

Claims 16 and 17 appear to be allowable as based upon an allowable base claim, in addition to reciting further limitations regarding the scope of the present invention. No specific comments were provided in the Office Action with regard to the recitations in claims 16 and 17. Accordingly, Applicant respectfully requests Notice of Allowance of claims 16 and 17.

Conclusion

Applicants have carefully reviewed the cited prior art references, along with the Examiner's comments, and respectfully believe that the presented claims distinguish the invention with particularity over the cited prior art references and knowledge generally available to one of ordinary skill in the art. In addition, Applicants respectfully believe that all outstanding issues presented in the most recent Office Action have been addressed. In view of the above discussion and amendments, Applicants respectfully submit that the present invention recited in claims 4-10 and 13-17 is allowable, and earnestly solicit notice to that affect. In addition, upon allowance of claims in the application, Applicant requests consideration of claims 2-3 and 11-12 for rejoinder and allowance. If it is believed that an interview would contribute to allowance of the claims, the Examiner is requested to contact the undersigned counsel at the number provided below.

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class Mail in an envelope addressed to: Asst. Commissioner for Patents, Washington, D.C. 20231, on February 3, 2003:

Brendan J. Kennedy
Name of applicant, assignee or Registered Representative

Brendan J. Kennedy
Signature

February 3, 2003
Date of Signature

Respectfully submitted,

Brendan J. Kennedy

Brendan J. Kennedy
Registration No.: 41,890
OSTROLENK, FABER, GERB & SOFFEN, LLP
1180 Avenue of the Americas
New York, New York 10036-8403
Telephone: (212) 382-0700

BJK:gl

APPENDIX B

VERSION WITH MARKINGS TO SHOW CHANGES MADE
37 C.F.R. § 1.121(b)(iii) AND (c)(ii)

SPECIFICATION:

Paragraph at page 9, line 19 to page 10, line 13:

A semiconductor photo-detector according to [Claim 1 of] the present invention which attains the above object is characterized in that: a first semiconductor layer having a first conduction type, a second semiconductor layer having a second conduction type, and a photo-absorption part comprising a photo-absorption layer sandwiched between the first semiconductor layer and the second semiconductor layer are disposed on a substrate: at least the photo-absorption layer is formed at a position apart inside by a finite length from an end surface of the substrate; the end surface of the second semiconductor layer and the substrate or the end surface of the substrate is provided with a light incident facet angled inwardly as it separates from the surface of the second semiconductor or the surface of the substrate; and light incident to the light incident facet is refracted at the light incident facet and transits the photo-absorption layer diagonally with respect to the layer thickness direction.

Paragraph at page 10, line 14 to page 11, line 14:

Further, a production method of the semiconductor photo-detector according to [Claim 2 of] the present invention which attains the above object is characterized in that: a first semiconductor layer having an intrinsic or a first conduction type, a second semiconductor layer having the same first conduction type, and a growth layer comprising a photo-absorption part including a photo-absorption layer sandwiched between the first semiconductor layer and the second semiconductor layer are disposed on a substrate; a main inside part of the first semiconductor layer at the surface side, or the inside part and part of photo-absorption layer is converted selectively to a second conduction type by diffusion of an impurity; and an end surface of the substrate side growth layer except for the photo-absorption layer or the substrate is provided with a light incident facet angled inwardly as it separates from the surface side from a position apart by a finite length in a direction parallel to the substrate surface with respect to the photo-absorption part comprising the photo-absorption layer, whereby obtaining a semiconductor

photo-detector in which incident light is refracted at the light incident facet and transits the photo-absorption layer diagonally with respect to the layer thickness direction.

Paragraph at page 11, line 15 to page 12, line 15:

Still further, a production method of the semiconductor photo-detector according to [Claim 3 of] the present invention which attains the above object is characterized in that: a first semiconductor layer having an intrinsic or a first conduction type, a second semiconductor layer having the same first conduction type, and a growth layer comprising a photo-absorption part including a photo-absorption layer sandwiched between the first semiconductor layer and the second semiconductor layer are disposed on a substrate; a main inside part of the first semiconductor layer at the surface side, or the inside part and part of photo-absorption layer is converted selectively to a second conduction type by ion implantation and subsequent anneal; an end surface of the substrate side growth layer except for the photo-absorption layer or the substrate is provided with a light incident facet angled inwardly as it separates from the surface side from a position apart by a finite length in a direction parallel to the substrate surface with respect to the photo-absorption part comprising the photo-absorption layer, whereby obtaining a semiconductor photo-detector in which incident light is refracted at the light incident facet and transits the photo-absorption layer diagonally with respect to the layer thickness direction.

Paragraph at page 12, line 16 to page 13, line 15:

Yet further, a semiconductor photo-detector according to [Claim 4 of] the present invention which attains the above object is characterized in that: a first conduction type semiconductor layer, a photo-absorption layer comprising an intrinsic or a first conduction type semiconductor layer, or a superlattice semiconductor layer or a multiple quantum well semiconductor layer, and a schottky electrode are disposed on a substrate; a semiconductor multilayered structure of large schottky-barrier height having a schottky barrier higher in schottky barrier height than the schottky barrier between the photo-absorption layer and the schottky electrode is formed between the photo-absorption layer and the schottky electrode; and an end surface of the substrate side growth layer except for the photo-absorption layer or the substrate is provided with a light incident facet angled inwardly as it separates from the surface

side from a position apart by a finite length in a direction parallel to the substrate surface with respect to the photo-absorption part comprising the photo-absorption layer, wherein incident light is refracted at the light incident facet and transits the photo-absorption layer diagonally with respect to the layer thickness direction.

Paragraph at page 13, line 16:

Yet further, a semiconductor photo-detector according to [Claim 5 of] the present invention which attains the above object is[, based on the semiconductor photo-detector of [Claim 4,] provided, wherein the semiconductor layer of large schottky-barrier height is $In_{1-x-y}Ga_xAl_yAs$ ($0 \leq x \leq 1$, $0 \leq y \leq 1$).

Paragraph at page 13, line 22 to page 14, line 2:

Yet further, a semiconductor photo-detector according to [Claim 6 of] the present invention which attains the above object is provided, [based on the semiconductor photo-detector of Claim 4,] wherein the semiconductor layer of large schottky-barrier height comprises $In_{1-x-y}Ga_xAl_yAs$ ($0 \leq x \leq 1$, $0 \leq y \leq 1$) and thin $In_{1-u}Ga_uAs_{1-v}P_v$ ($0 \leq x \leq 1$, $0 \leq y \leq 1$) disposed thereon.

Paragraph at page 14, line 3:

Yet further, a semiconductor photo-detector according to [Claim 7 of] the present invention which attains the above object is provided, [based on the semiconductor photo-detector of any one of Claims 4, 5 and 6,] wherein a compositionally graded or step-graded layer from the same composition as the photo-absorption layer to the same composition as the semiconductor layer of large schottky-barrier height is disposed between the photo-absorption layer and the semiconductor layer of large schottky-barrier height.

Paragraph at page 14, line 14:

The [invention] semiconductor photo-detector according to [Claims 1 to 7] the present invention is characterized in that the light incident facet can be formed very flat and stable as compared with the prior art.

Paragraph at page 16, line 8:

Yet further, a semiconductor photo-detector according to [Claim 8 of] the present invention which attains the above object is characterized in that: a photo-absorption part comprising a semiconductor multilayer structure including a photo-absorption layer is provided on a substrate, an end surface is provided with a light incident facet angled inwardly as it separates from the surface side, and a V- or U-shaped groove is provided in opposition to the light incident facet, whereby light incident from an optical fiber disposed in the groove is refracted at the light incident facet and transits the photo-absorption layer diagonally with respect to the layer thickness direction.

Paragraph at page 16, line 22 to page 17, line 2:

Yet further, a production method of semiconductor photo-detector according to [Claim 9 of] the present invention which attains the above object is provided, [based on the production method of semiconductor photo-detector according to Claim 8,] wherein the light incident facet and the V- or U-shaped groove are formed simultaneously by etching.

Paragraph at page 17, line 3:

Yet, further, a semiconductor photo-detector according to [Claim 10 of] the present invention which attains the above object is provided, [based on the semiconductor photo-detector according to Claim 8,] wherein the light incident facet and its vicinity are buried in an organic substance.

Paragraph at page 17, line 9:

Yet further, production method of semiconductor photo-detection device according to [Claim 11 of] the present invention which attains the above object is fabricated with the light incident facet and its vicinity are buried in an organic substance, [using the semiconductor photo-detector according to Claim 10,] and after making optical coupling with an optical waveguide, by removing the organic substance.

Paragraph at page 17, line 16:

Yet further, a production method of semiconductor photo-detection device according to [Claim 12 of] the present invention which attains the above object is characterized in that the light incident facet and its vicinity are buried in an organic substance, and, [using the semiconductor photo-detector according to Claim 10,] after making optical coupling with an optical waveguide, space between the semiconductor photo-detector and the optical waveguide is buried in with an organic substance.

Paragraph at page 17, line 25 to page 18, line 4:

In the [invention,] semiconductor photo-detection device according to [Claims 8 to 12] the present invention, the device has a groove in opposition to the light incident facet to be a fiber guide for conducting incident light, which part acts as a fiber guide, and high precision positioning is possible only by setting the fiber.

Paragraph at page 18, line 23 to page 19, line 11:

Yet further, a semiconductor photo-detector according to [Claim 13 of] the present invention which attains the above object is characterized in that: a photo-absorption part comprising a semiconductor multilayer structure including a photo-absorption layer is provided on a substrate; an end surface is provided with a light incident facet angled inwardly as it separates from the surface side, the substrate is protruded by a finite length from a tip part of the end surface, and light incident from an optical waveguide, precisely positioned by contacting against the protruded part of the substrate, is refracted at the light incident facet and transits the photo-absorption layer diagonally with respect to the layer thickness direction.

Paragraph at page 19, line 12:

Since in the device of the invention [according to Claim 13] described above, part of substrate is protruded by a finite length from the tip of the light incident facet, this part acts as a stopper when a fiber is brought close from a far end in the optical axis direction, and the fiber tip will never contact against the important light incident facet to be damaged.

Paragraph at page 19, line 24 to page 20, line 16:

Yet further, a semiconductor photo-detector according to [Claim 14 of] the present invention which attains the above object is characterized in that: a photo-absorption part comprising a semiconductor multilayer structure including a photo-absorption layer is provided on a substrate; an end surface is provided with a light incident facet angled inwardly as it separates from the surface side, a main reaching area of refracted incident light at the semiconductor layer above the photo-absorption layer is terminated with a substance having a smaller refractive index than the semiconductor layer, incident light is refracted at the light incident facet and transits the photo-absorption layer diagonally with respect to the layer thickness direction, and the transit light is total reflected by the substance of small refractive index on the semiconductor layer above the photo-absorption layer.

Paragraph at page 20, line 17:

[Since, in] In the semiconductor photo-detector device of the present invention [according to Claim 14], a main reaching area of refracted incident light at the semiconductor layer above the photo-absorption layer is terminated with a substance having a smaller refractive index than the semiconductor layer, light is completely total reflected on the upper surface, the refracted light transits two times the photo-absorption layer, and the effective absorption length is increased to two times.

Paragraph at page 21, line 8:

A semiconductor photo-detection device according to [Claim 15 of] the present invention which attains the above object is characterized by comprising a refraction type semiconductor photo-detector comprising a photo-absorption part including a semiconductor multilayer structure including a photo-absorption layer disposed on a substrate and an end surface provided with a light incident facet angle inwardly as it separates from the surface side, and an optical waveguide disposed in opposition to the device; space between the refraction type semiconductor photo-detection device and the optical waveguide is buried in a solid or liquid; whereby light incident to the light incident facet of the photo-detection device from the optical waveguide is refracted at the light incident facet with respect tot he layer thickness direction.

Paragraph at page 21, line 26 to page 22, line 13:

Since in the semiconductor photo-detection device of the present invention, [according to claim 15,] space between the refraction type semiconductor photo-detector and the optical waveguide is buried in a solid or liquid having a refractive index of greater than 1, by appropriately selecting the solid or liquid used to change the refractive index, it is possible to change the refraction angle on the photo-detector incident facet even when using a refraction type semiconductor photo-detector cut from the same wafer having the same layer structure and the same mesa angle construction thus the responsivity can be adjusted according to the application.

CLAIMS:

4. (Amended) A semiconductor photo-detector [characterized in that:], comprising:

an intrinsic or a first conduction type semiconductor layer, a photo-absorption layer comprising a superlattice semiconductor layer or a multiple quantum well semiconductor layer, and a schottky electrode are disposed on a substrate having a top surface and an end surface meeting at an edge;

said photo-absorption layer being spaced from said edge of said substrate adjoining said end surface;

a semiconductor multilayer structure of large schottky-barrier height having a schottky barrier higher in schottky barrier height than [the] a schottky barrier between said photo-absorption layer and said schottky electrode is formed between said photo-absorption layer and said schottky electrode; and

[an end surface of the substrate side growth layer except for said photo-absorption layer or said substrate is provided with] a light incident facet on said end surface and forming an acute angle with said top surface [angled inwardly as it separates from the surface side from a position apart by a finite length in a direction parallel to said substrate surface with respect to the photo-absorption part comprising said photo-absorption layer],]

wherein incident light is refracted at said light incident facet and transits said photo-absorption layer [diagonally] at an angle with respect to [the] an orthogonal of said photo-absorption layer [thickness direction].

8. (Amended) A semiconductor photo-detector [characterized in that:], comprising:

a substrate having a top surface and an end surface meeting at an edge;

a photo-absorption part comprising a semiconductor multilayer structure including a photo-absorption layer [is] provided on [a] said top surface of said substrate and spaced from said edge;

[an end surface is provided with] a light incident facet [angled inwardly as it separates from the surface side] on said end surface and forming an acute angle with said top surface; and

a V- or U-shaped groove [is provided in opposition] opposed to said light incident facet,

wherein incident light [incident] from an optical fiber disposed in said groove is refracted at said light incident facet and transits said photo-absorption layer [diagonally] at an angle with respect to [the] an orthogonal of said photo-absorption [the] layer [thickness direction].

9. (Amended) [A production method of the] The semiconductor photo-detector as claimed in Claim 8, wherein said light incident facet and said V- or U-shaped groove are fabricated simultaneously by etching.

13. (Amended) A semiconductor photo-detector [characterized in that], comprising:

a substrate having a top surface and an end surface meeting at an edge;

a photo-absorption part comprising a semiconductor multilayer structure including a photo-absorption layer [is] provided on [a] said top surface of said substrate;

[an end surface is provided with] a light incident facet [angled inwardly as it separates from the surface side] on said end surface and forming an acute angle with said top surface; and

said surface including an abutting portion extending from said substrate [is protruded by a finite length from a tip of said end surface at said light incident facet side,] a specified lateral distance beyond said edge; and

wherein incident light [incident] from an optical waveguide precisely positioned by contacting against said [protruded part] abutting portion of said [substrate] end surface is refracted at said light incident facet and transits said photo-absorption layer [diagonally] at an angle with respect to [the] an orthogonal of said photo-absorption layer [thickness direction].

14. (Amended) A semiconductor photo-detector [characterized in that], comprising:

a substrate having a top surface and an end surface meeting at an edge;

a photo-absorption part comprising a semiconductor multilayer structure including a photo-absorption layer [is] provided on [a] said top surface of said substrate;

[an end surface is provided with] a light incident facet [angled inwardly as it separates from the surface side] on said end surface and forming an acute angle with said top surface; and

[a main reaching area of incident light refracted at] an upper layer of said photo-absorption layer is terminated with a substance having a smaller refractive index than a semiconductor layer,

wherein [incident] light incident is refracted at said light incident facet and transits said photo-absorption layer [diagonally] at an angle with respect to [the] an orthogonal of said photo-absorption layer [thickness direction, and] such that said transit light [total] is totally reflected by said smaller refractive index substance of said upper layer of said photo-absorption layer.

15. (Amended) A semiconductor photo-detection device [characterized in that], comprising:

a substrate having a top surface and an end surface meeting at an edge;

a photo-absorption part comprising a semiconductor multilayer structure including a photo-absorption layer [is] provided on [a] said top surface of said substrate;

[a refraction type semiconductor photo-detector provided on an end surface with] a light incident facet [angled inwardly as it separates from the surface side, and] on said end surface and forming an acute angle with said top surface;

an optical waveguide [is] disposed opposing said [device] light incident facet; and

[space] a solid or liquid interposed between said [refraction type semiconductor photo-detector] light incident facet and said optical waveguide [is buried in with a solid or liquid,];

wherein incident light [incident] from said optical waveguide applied to said light incident facet [of said photo-detector] is refracted at said light incident facet and transits said photo-absorption layer [diagonally] at an angle with respect to [the] an orthogonal of said photo-absorption layer [thickness direction].